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August 09, 2004

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APPLICATION NUMBER: ***60/477,528***
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Certified by

Jon W Dudas

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Approved for use through 4/30/2003. OMB 0651-0032
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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06/11/03

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Charles	Perkins	Boston, Massachusetts

Additional inventors are being named on the 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

DETECTION OF LARGE LEAKS IN HERMETICALLY SEALED COMPONENTS WITH A SMALL INTERNAL VOLUME

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

- [X] Specification *Number of Pages* 3
- [ ] CD(s), Number
- [X] Drawing(s) *Number of Sheets* 2
- [X] Other (specify) Return Receipt Postcard
- [ ] Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

- [ ] Applicant claims small entity status. See 37 CFR 1.27.
- [ ] A check or money order is enclosed to cover the filing fees.
- [X] The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 50-0895
- [ ] Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $160

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

- [X] No.
- [ ] Yes, the name of the U.S. Government agency and the Government contract number are: ____________

Respectfully submitted,

SIGNATURE Bella Fishman

Date 6/11/03

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REGISTRATION NO. 37,485
(If appropriate)

Docket Number: 03-19 US PRO

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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PROVISIONAL APPLICATION COVER SHEET
Additional Page

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Docket Number	03-19 US PRO

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Docket No.: 03-19 US PRO

VARIAN

DETECTION OF LARGE LEAKS IN HERMETICALLY SEALED COMPONENTS WITH A SMALL INTERNAL VOLUME

DESCRIPTION OF THE INVENTION

The invention concerns a new method for helium leak testing of, but not limited to, large-leak testing hermetically sealed components. The key feature is a sensor composed of a permeable material that selectively permeates helium. This could be, but not limited to, a polymer or a quartz material in any shape or form (sphere, cylinder, capillary, etc.). For applications where quartz is used, the quartz is heated by a heater, such as resistive, radiant, or other appropriate heat transfer means, to allow selective permeation of helium through the helium sensor. It is known that the permeation rate of helium can be controlled by temperature to adjust the sensitivity of the sensor. This new helium sensor can be used in a leak test system under vacuum, at ambient pressure, or at a slight over pressure.

In a conventional helium leak detection method, where a large leak is present in a small part, the helium can be pumped away so fast during the rough pump cycle that no leak reading is possible and the leaking part is accepted. This problem has existed in the industry for a very long time. The following methods have been utilized for some application with limited results.

- Measure the difference in evacuation time between a leaky or non-leaky part. (Not enough resolution)
- A volumetric expansion method. (Not enough resolution)

Figure 1 shows the configuration of a solution consisting of a vacuum flange, a vacuum enclosure, a sensor, a sputter ion pump, and a controller that supplies power to the ion pump and reads back the pump current. Alternately, a conventional leak detector can be used with the sensor assembly in various applications, for example, an application where a fine leak test is required after the large leak test. Figure 2 shows a configuration with a conventional leak detector.

The internal volume of the part to be tested has been previously pressurized with helium or has been exposed to a high helium concentration in a bombing chamber before inserting it into the test chamber of the leak detector

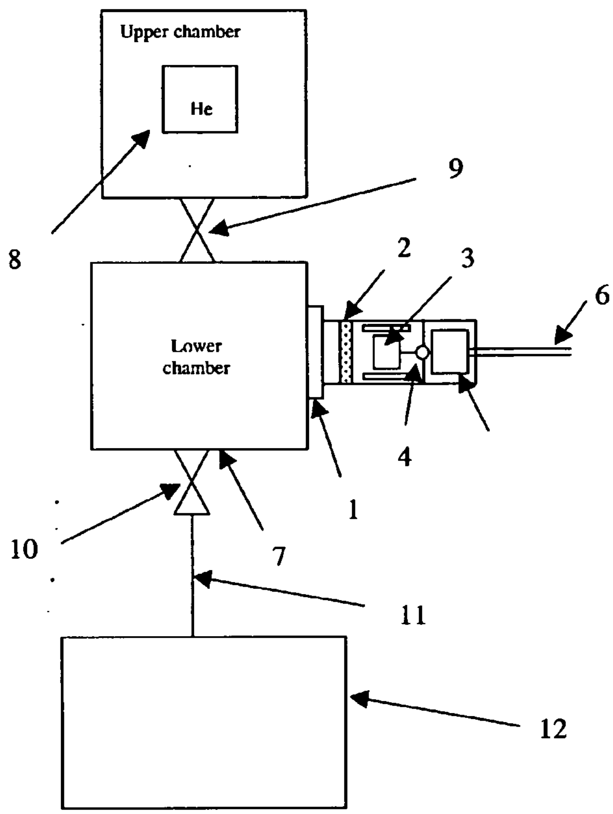
In the new concept, two vacuum chambers are inter-connected by a valve (A), while a vacuum pump is connected to the lower chamber via a valve (B). The helium sensor is connected to the lower chamber. With valve A closed to isolate the two chambers from each other, the part to be tested is inserted into the upper chamber. At the beginning of the test, the helium concentration in the chamber is at ambient levels or alternately, a nitrogen flushing operation can reduce the helium concentration to enhance sensitivity capability for the large leak measurement described in this paper.

With valve A closed, valve B is opened to pump a vacuum in the lower chamber. Valve B is then closed so there is no pumping in either chamber. Valve A is opened between the two chambers and the gas from chamber A is permitted to flow into the lower chamber until pressure equilibrium is achieved. Helium leaking from the test part passes into the lower chamber and increases the helium concentration in the vacuum environment until a pressure equilibrium is reached. The resulting helium concentration in the vacuum can be now be measured by the sensor or leak detector. Only helium will pass through the permeable window and increase the vacuum pressure in the sensor ion pump or leak detector. The resulting increase of ion pump current is proportional to the increase in helium pressure and the leak rate. For the leak detector configuration, the leak rate can be read directly. The key feature of this invention is that the helium sensor has zero pumping speed in the test chamber. It does not remove the gas from the vacuum environment as with prior art devices. It detects the helium leak, but does not pump the helium away so large leak detection is made more accurately, more reliably, and with more sensitivity than previous methods used in the industry. If no large leak is detected the conventional leak detector cycle can be continued, which means further evacuation of the chambers (with valve A open) and finally connecting the vacuum environment to the conventional leak detector, for example a mass spectrometer leak detector, for fine leak measurement

SUMMARY OF THE INVENTION

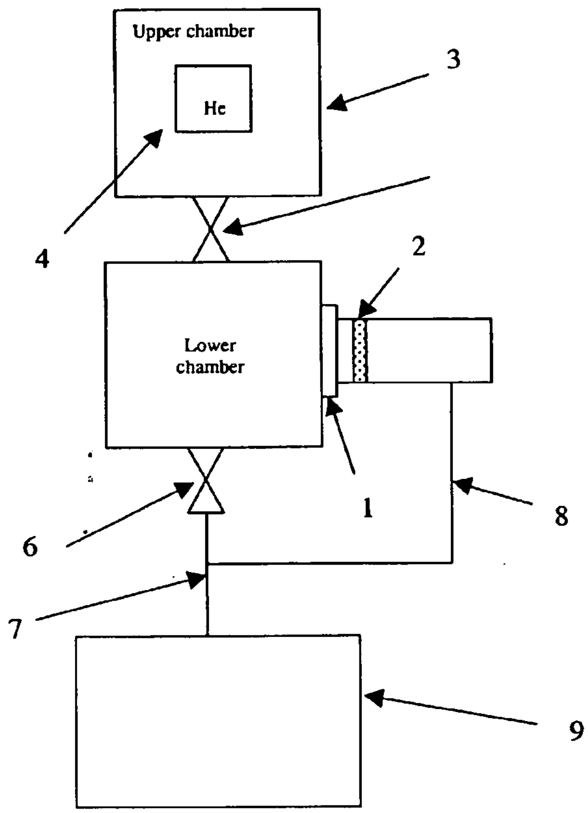
1. A leak test device made of permeable material of any shape or form (sphere, cylinder, capillary, etc.)
2. A heater (resistive, radiant, or a similar technology) heats the quartz material to allow helium permeation, while selectively blocking most other gases water and dust. A heater is not required where a permeable polymer, for example is used.
3. When heated to a certain temperature, the quartz material permeates helium at a constant rate.
4. The temperature can be adjusted to control the permeation rate and therefore the sensitivity.
5. The sensor can be installed at the inlet of an ion pump, which is power by a high voltage, between 2000 and 9000 volts. The ion pump current is proportional to the vacuum pressure inside the sensor. Helium that permeates through the quartz window affects the vacuum pressure at a rate proportional to the leak rate. The ion pump current is therefore proportional to the leak rate. Alternately, the sensor can utilize a conventional leak detector to read the helium concentration instead of the ion pump current.
6. The sensor can operate either with vacuum at the inlet flange or with atmospheric pressure at the inlet flange or at a pressure slightly higher than atmospheric.
7. The sensor can operate in an atmosphere that contains various gases, particles such as dust, or in wet environments.
8. The sensor can be installed as shown in Figure 1 and 2 and can be used for accurate testing for large leaks for parts of various sizes and is particularly useful for small volume parts with a large leak.

FIGURE 1 Helium Sensor for a Large Leak Test With Ion Pump



1 – Vacuum flange
2 – Permeable membrane
3 – Ion pump
4 – Ion pump feedthrough
5 – Controller
6 – Power/signal cable
7 – Test chamber
8 – Part to be tested
9 – Valve A
10 – Valve B
11 – Pipe to vacuum or conventional leak detector
12 - Conventional leak detector

FIGURE 2 Helium Sensor for a Large Leak Test With Conventional Leak Detector



1 – Vacuum flange
2 – Permeable window
3 – Test chamber
4 – Part to be tested
5 – Valve A
6 – Valve B
7 – Pipe to vacuum or conventional leak detector
8 – Pipe from permeable window to conventional leak detector
9 – Conventional leak detector